

BULLETIN

OF THE INSTITUTE OF METALS

VOLUME 4

FEBRUARY 1958

PART 6

INSTITUTE NEWS

Membership

The total active membership of the Institute on 31 December 1957 was 4908. In this, the Institute's Golden Jubilee Year, it is hoped that a total of over 5000 will be exceeded. The Secretary will be glad to send to prospective applicants for membership particulars of membership, forms of application, and specimen copies of the monthly *Journal* and *Metallurgical Abstracts*.

Symposium on "Metallurgical Aspects of Semi-Conductors"

As briefly announced in the January *Bulletin*, the Metal Physics Committee of the Institute is arranging a one-day symposium on "Metallurgical Aspects of Semi-Conductors", to be held on Tuesday 25 February at the College of Technology, Gosta Green, Birmingham.

At the morning session, beginning at 9.30 a.m., short papers will be given on:

"Purification and Growth of Silicon Crystals", by J. M. WILSON (*Standard Telecommunications Laboratories, Ltd.*).

"Purification and Growth of Compounds", by W. D. LAWSON (*Royal Radar Establishment*).

In the afternoon there will be short papers on:

"Structural Defects and Deformation in Semi-Conductors", by J. W. MITCHELL (*University of Bristol*).

"Deformation of Germanium", by W. BARDSLEY and R. L. BELL (*Royal Radar Establishment*).

"Deformation of Indium Antimonide", by J. W. ALLEN (*Services Electronics Research Laboratory*).

"The Direct Observation of Dislocation Structures in Semi-Conductors by Transmission Electron Microscopy", by R. PHILLIPS (*A.E.I. Research Laboratories*).

The chair will be taken by Professor G. V. RAYNOR (*University of Birmingham*), who will also give a short introduction at the morning session.

The meeting will be open to members and visitors without tickets. There will be no preprints of the papers. An exhibition dealing with semi-conductors will be held in a room adjoining the lecture hall on the day of the symposium; it will also be open on the preceding evening.

General Board of the National Physical Laboratory

Dr. L. B. PFEIL, F.R.S., has succeeded Major C. J. P. BALL as a representative of the Institute on the General Board of the National Physical Laboratory.

National Committee for Crystallography

Dr. N. P. ALLEN, F.R.S., has succeeded Mr. H. W. L. PHILLIPS as the Institute's representative on the National Committee for Crystallography.

Representation on the Council

Captain K. H. SMITH, O.B.E., has succeeded Captain (E) W. F. B. LANE, D.S.C., R.N., as Admiralty representative on the Council of the Institute.

Election of Members

The following 14 Ordinary Members, 5 Junior Members, and 23 Student Members were elected on 31 December 1957:

As Ordinary Members

BEACH, Norman, A.I.M., Assistant Metallurgist, Research and Development Department, Hoffman Manufacturing Co., Ltd., New Street, Chelmsford, Essex.

BRYANT, Philip Stephen, B.Sc., A.M.I.Chem.E., Extraction Metallurgist, Murex, Ltd., Rainham, Essex.

FLINN, Professor Richard A., M.S., Sc.D., Professor of Metallurgical Engineering, Department of Chemical and Metallurgical Engineering, University of Michigan, Ann Arbor, Mich., U.S.A.

HORVÁTH, Professor Zoltán, Dr.Ing., Dean of the Faculty of Metallurgical Engineering, and Professor, Institute for Non-Ferrous Metallurgy, Technical University of Industry, Miskolc, Hungary.

IVEY, Charles Robert, Director of Manufacturing, Emco, Ltd., Box 698, London, Ont., Canada.

KENNEDY, Professor Alfred James, B.Sc., Ph.D., A.M.I.E.E., F.Inst.P., Professor of Materials and Metallurgy, The College of Aeronautics, Cranfield, Bletchley, Bucks.

LLOYD-LUCAS, John Brian, Assistant Works Manager, Mark Perks, Ltd., Tenby Street North, Birmingham 1.

MOORE, John Collard, A.I.M., Research Metallurgist, The Plessey Company, Ltd., Vicarage Lane, Ilford, Essex.

REINACHER, Gerhard Wilhelm, Dr.-Ing., Stellvertretender Leiter des Metall-Laboratoriums, Degussa-Hanau, Leipzigerstrasse 10, Hanau/Main, Germany.

RETHWISCH, Francis B., M.S., c/o Reynolds Metals Company, 2500 South Third Street, Louisville 1, Ky., U.S.A.

SCHAUFELBERGER, Felix Alfred, D.Sc., Head, Metals Division, CIBA, Basle, Switzerland.

SCHEIL, Merrill A., M.S. Metallurgy, B.S.Chem.Eng., Director, Metallurgical Research, A.O. Smith Corporation, Milwaukee 1, Wis., U.S.A.

SILCOCK, (Miss) Jeanne Mary, B.Sc., Investigator, Fulmer Research Institute, Stoke Poges, Bucks.

PERSONAL NOTES

WYSZYNSKI, Apoloniusz, Assistant Chemist, W. Canning and Co., Ltd., Great Hampton Street, Birmingham 18.

As Junior Members

BALDWIN, Peter Harris, B.Met., 111 Vale Road, Northfleet, Kent.

BAYLISS, Raymond Harold Thomas, A.C.T.(Birm.), Metallurgist, Birmingham Battery and Metal Co., Ltd., Selly Oak, Birmingham.

JOHNSON, Herbert H., Jr., B.S., Ph.D., Department of Metallurgy, Lehigh University, Bethlehem, Pa., U.S.A.

JOHNSON, Michael Peter, B.Sc., Metallurgist, Atomic Power Department, English Electric Co., Ltd., Whetstone, Leicester.

LAWRENCE, James Arthur, L.I.M., Metallurgist, Birmingham Battery and Metal Co., Ltd., Selly Oak, Birmingham.

As Student Members

ASHBY, Michael Farries, B.A., Department of Metallurgy, University of Cambridge.

BREESE, Paul, Trainee Manager, Lancashire Steel Corporation, Ltd., Irlam, Manchester.

BROWN, Alan John, Undergraduate, Department of Metallurgy, University of Cambridge.

BUCKLEY, Robert Andrew, B.Sc., Research Student, Department of Metallurgy, University of Manchester.

COULSON, John Michael Dudley, Undergraduate, Department of Metallurgy, King's College, University of Durham, Newcastle-on-Tyne.

EDINGTON, Jeffrey William, Undergraduate, Department of Metallurgy, University of Birmingham.

EDWARDS, Norman Anthony, Undergraduate, Department of Metallurgy, University of Liverpool.

FRYER, Peter Charles, Undergraduate, Department of Metallurgy, University of Cambridge.

HALL, Roger, Undergraduate, Department of Metallurgy, University of Cambridge.

HARDY, Roy, Undergraduate, Department of Metallurgy, King's College, University of Durham, Newcastle-on-Tyne.

KEEN, John Michael, Undergraduate, Department of Physical Metallurgy, University of Birmingham.

MARTINEZ VIDAL, Carlos Antonio, Ing. Mec. y Electr., Comisión Nacional de la Energía Atómica, Buenos Aires, Argentina. (*Temporarily at:*) Max-Planck-Institut für Metallforschung, Seestrasse 75, Stuttgart, Germany.

MINTON, Clive Dudley Thomas, B.A., Research Student, Department of Metallurgy, University of Cambridge.

MORIMOTO, Toru, M.Eng., Graduate Student, Department of Mining and Metallurgy, College of Engineering, University of Wisconsin, Madison 6, Wis., U.S.A.

MURRAY, John Graham DeBois, Undergraduate, Department of Metallurgy, University of Cambridge.

NEWTON, John David, Undergraduate, Department of Metallurgy, University of Manchester.

PETERS, Edward Tehle, B.A., B.S., Research Assistant, University of Wisconsin, 1509 University Avenue, Madison 6, Wis., U.S.A.

RANZETTA, Gerald Victor Thomas, B.Sc. (Eng.), Research Student, Royal School of Mines, Imperial College of Science and Technology, London, S.W.7.

ROBERTS, Neil Jeffrey, Undergraduate, Department of Metallurgy, University of Manchester.

SUMNER, Sidney Edward, Student Metallurgist, English Steel Rolling Mills Corporation, Openshaw Works, Wood Street, Openshaw, Manchester.

TIPPER, Peter William, Student of Metallurgy, 2 Linden Terrace, Whitley Bay, Northumberland.

TOWNSEND, Derek Walter, Undergraduate, Department of Physical Metallurgy, University of Birmingham.

WATKINS, Alan Keith, Undergraduate, Department of Metallurgy, University of Birmingham.

"Metallurgical Reviews"

The last part of Vol. 2 of *Metallurgical Reviews* has recently been issued. It contains three contributions: "The Production and Properties of Super-Purity Aluminium", by Dr. T. G. Pearson and Mr. H. W. L. Phillips; "The Theory of Extrusion", by Dr. J. F. W. Bishop; and "Pickling, Descaling, and Derusting of Steels", by Mr. W. Bullough.

With Vol. 2, No. 8 all subscribers should receive a binding case. Binding is undertaken by Mr. W. A. Newark, 2 Clerkenwell Green, London, E.C.1, at a cost of 11s. per volume, including postage. Mr. Newark cannot, however, accept orders for binding from outside the United Kingdom.

Prices of Institute Publications

Owing to recent increases in postage and in general administrative costs, it has been found necessary to raise the subscription rate of the *Journal* and *Metallurgical Abstracts* and the price of some of the Institute's monographs.

The revised price list will be found on p. 10 of this issue.

PERSONAL NOTES

MR. J. C. COLQUHOUN has resigned his position as Managing Director of The Manganese Bronze and Brass Co., Ltd. He will, however, retain the Chairmanship and continue to take an active interest as an executive of the Company.

DR. A. H. COTTRELL has been elected a Foreign Member of the Swedish Royal Academy of Sciences.

MR. P. R. DIXON has left Sheffield University and taken up an appointment with G.E.C.-Simon Carves Atomic Energy Group, Erith, Kent.

DR. D. GEISELMAN has left Purdue University and is now a Research Metallurgist with the Electro Metallurgical Company, Niagara Falls, N.Y.

MR. F. G. HAYNES has left Metropolitan-Vickers Electrical Co., Ltd., to take up an appointment in the Development and Research Department of The Mond Nickel Co., Ltd., Birmingham.

MAJOR C. JOHNSON has relinquished his appointment as Manager of the Precious Metals Refinery, The Mond Nickel Co., Ltd., Acton, on reaching the retiring age. He had been with the Company for 38 years.

MR. W. W. KEE has been appointed Managing Director of Enfield Rolling Mills (Aluminium), Ltd.

MR. N. C. LAKE has been appointed Deputy Managing Director of Head, Wrightson and Co., Ltd. He was previously Managing Director of the Head, Wrightson Machine Co., Ltd.

LETTER TO THE EDITOR

DR. T. S. LIU is now engaged in the Metallurgical Research Division of the Titanium Metals Corporation of America, Henderson, Nevada.

DR. PAUL MELCHIOR has been presented with the DIN Ring of Honour in recognition of his outstanding services to standardization in Germany.

DR. I. MINKOFF has left the Massachusetts Institute of Technology to become Senior Lecturer in Metallurgy at the Israel Institute of Technology, Haifa.

MR. A. R. RAPER has succeeded Major Johnson as Manager of the Precious Metals Refinery, The Mond Nickel Co., Ltd., Acton.

MR. E. ROBSON has been appointed Managing Director of The Manganese Bronze and Brass Co., Ltd. in succession to Mr. Colquhoun. He was previously Deputy Managing Director.

DR. E. SCHEUER, Head of the Laboratories of International Alloys, Ltd., Aylesbury, has been appointed a Director of the Company.

MR. A. SPEIRS has left Edwin Danks and Co., Ltd., Oldbury, to become Metallurgist to John Brown and Co. (Clydebank), Ltd., Clydebank.

DR. G. J. THOMAS, formerly Branch Manager of the Birmingham works of International Alloys, Ltd., has been appointed a Director of the Company.

MR. S. P. THOMPSON has left British Insulated Callenders Cables, Ltd., and is now with Standard Telephones and Cables, Ltd., Paignton, Devon.

MR. E. M. WORLEY has graduated from Cambridge University and is now a Research Metallurgist (Trainee) with the Steel Division of The Steel Company of Wales, Ltd., Port Talbot.

OBITUARY

Mr. W. W. Franklin

Mr. W. W. Franklin, M.I.Mech.E., Technical Director of Davy and United Engineering Co., Ltd., Sheffield, died suddenly at his home in Derbyshire on 18 December 1957. He was 57.

William Walter Franklin served his apprenticeship with Davy-United and, apart from service in the Royal Navy during the 1914-18 War, spent his entire career with the Company. In 1931 he took charge of the Estimating Drawing Office, later becoming Rolling Mill Department Manager and Proposal Manager. In July 1947 he became Chief Engineer, and in 1951 was appointed to the Board of the Company as Technical Director.

Mr. Franklin's reputation as a rolling-mill engineer was firmly established, particularly in the field of section rolling, and the majority of the important new plants installed in Britain under the steel industry's post-war development schemes were engineered under his direct personal supervision. As well as being a member of the Institution of Mechanical Engineers, he was also a member of the Iron and Steel Institute, the Institute of Metals, the Association of Iron and Steel

Engineers of America, the Rolling Mill Plant Committee of the British Iron and Steel Research Association, and the Sheffield Society of Engineers and Metallurgists.

Mr. P. M. Parish

Philip Maxey Parish was born on 17 March, 1892 and died suddenly at Gibraltar on 11 November, aged 65, from a heart attack.

He joined me in Fry's Metal Foundries, Ltd., in its very early days on 23 June, 1913. After serving $4\frac{1}{2}$ years in the 6th Battalion, City of London Rifles, he returned to Fry's Metal Foundries in February, 1919, remaining with them altogether 44 years, until his retirement early this year as Chairman of the Company. Since then he had travelled extensively and had been round the world.

He had an outstandingly successful business career and a large share in the progress of Fry's Metal Foundries and of its sister-company, Fry's Diecastings, Ltd. He had been a member of the Institute of Metals since 1920.

JOHN FRY

LETTER TO THE EDITOR

Sulphide Precipitation from O.F.H.C. Copper

In the preparation of specimens of O.F.H.C. copper for metallographic examination, considerable difficulty has been encountered in obtaining a polished surface which is free of fine pits or markings.

Systematic variation of electrolyte composition, voltage, current density, temperature, and electrode configuration did not lead to any improvement in the surface finish, and the possibility that the pits were caused by a finely dispersed precipitate in the copper was examined.

Two identical specimens were prepared and annealed *in vacuo* for 30 min. at 920°C . One was water-quenched while the other was furnace-cooled to room temperature, and both were then given identical electropolishing treatments under the following conditions:

Electrolyte	600 g./l. orthophosphoric acid
Potential	1.5 V.
Current density	0.5 amp./in. ²
Polishing time	30 min.
Cathode	copper

On removal from the electropolishing solution, the specimens were washed in dilute orthophosphoric acid, then in a stream of water, and finally in alcohol.

The quality of the polish was quite different on the two specimens; the surface of the slowly cooled specimen was covered with fine markings, as shown in Fig. 1 (a), whereas the quenched specimen Fig. 1 (b) was relatively clean.

This difference due to heat-treatment suggested that precipitation had occurred in the slowly cooled specimen, and confirmation was obtained from an electron-diffraction examination* in which three continuous diffraction arcs were superimposed on the background pattern from the matrix

* The electron-diffraction examination was made by Dr. J. Sander of the CSIRO Division of Tribophysics.

copper. The number of lines was insufficient for a definite identification of the precipitate, but it was found that the three lines corresponded to those occurring in the diffraction pattern from cuprous sulphide but not from cupric sulphide, cuprous oxide, cupric oxide, or cupric phosphate.

The sulphur content of the copper used in the present investigation was 0.0021%, but since the solubility of sulphur in copper is extremely low (Smart and Smith¹ claim that the

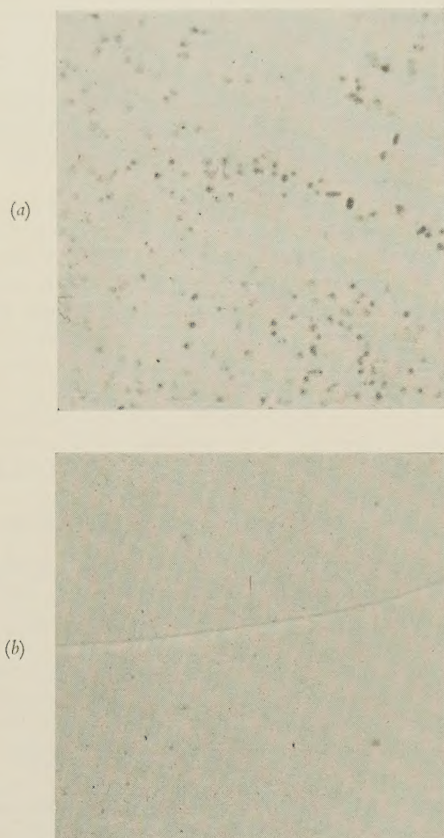


FIG. 1.—O.F.H.C. Copper (a) slowly cooled from 920° C.; (b) quenched from 920° C. $\times 300$.

solubility at 600° C. is less than 0.0003%), some sulphide precipitation from the slowly cooled specimen would still be expected.

It is suggested, therefore, that one of the difficulties in obtaining a satisfactory surface finish for metallographic examination on electropolished copper is sulphide precipitation, and that if this is to be avoided it is necessary either to use copper of very much lower sulphur content than is normally available or to retain the sulphur in solid solution by a suitable quenching treatment.

D. R. MILLER

CSIRO Physical Metallurgy Section,
Baillieu Laboratory,
University of Melbourne,
Australia.

REFERENCE

1. J. S. Smart and A. A. Smith, *Trans. Amer. Inst. Min. Met. Eng.*, 1946, **166**, 144.

NEWS OF LOCAL SECTIONS AND ASSOCIATED SOCIETIES

New Associated Society

The Southampton Metallurgical Society has become an Associated Society. In consequence, its programme of meetings will in future be published in the programme booklet issued to members by the Institute, and members will be entitled to attend the meetings of the Society without the payment of an additional subscription.

Meetings are usually held at Southampton University. The President of the Society is Dr. O. P. EINERL and the Honorary Secretary is Mr. S. W. HALLWOOD, c/o Folland Aircraft, Ltd., Hamble, Southampton.

JOINT ACTIVITIES

Beilby Memorial Awards

From the interest derived from the invested capital of the Sir George Beilby Memorial Fund, at intervals to be determined by the Administrators representing the Royal Institute of Chemistry, the Society of Chemical Industry, and the Institute of Metals, awards are made to British investigators in science to mark appreciation of records of distinguished work. Preference is given to investigations relating to the special interests of Sir George Beilby, including problems connected with fuel economy, chemical engineering, and metallurgy. The awards are made, not on the result of any competition, but in recognition of continuous work of exceptional merit bearing evidence of distinct advancement in science and practice.

In general, awards are not applicable to workers of established repute, but are granted as an encouragement to younger men who have done original independent work of exceptional merit over a period of years.

The Administrators are empowered to make more than one award in a given year if work of sufficient merit by several candidates is brought to their notice. For 1956 an award of 150 guineas was made to Mr. R. W. Kear.

Consideration will be given in due course to the making of an award or awards from the Fund for 1957. Outstanding work of the nature indicated may be brought to the notice of the Administrators, either by persons who desire to recommend the candidate or by the candidate himself, *not later than 28 February 1958*, by letter addressed to the Convener of the Administrators, Sir George Beilby Memorial Fund, The Royal Institute of Chemistry, 30 Russell Square, London, W.C.1.

The letter should be accompanied by *nine copies* of a short statement on the candidate's career (date of birth, education and experience, degrees and other qualifications, special awards, &c., with dates) and of a list of titles, with references, of papers or other works published by the candidate, independently or jointly. Candidates are also advised to forward one reprint of each published paper of which copies are available.

OTHER NEWS

Graduate Course in Foundry Science and Engineering

The Department of Industrial Metallurgy in the University of Birmingham announces that it is proposed to establish a

graduate course dealing specifically with foundry science and engineering. This course will not compete with the course given at the National Foundry College, Wolverhampton; rather will its aim and scope be complementary to those of the Foundry College. The course will be of nine months' duration, leading to a Diploma in graduate studies, or one year's duration, leading to a M.Sc. degree. The present plans are to hold this course every two or three years. During the intervening years similar graduate courses will be held in other fields of industrial metallurgy.

The broad aim of the course is to provide advanced university training in the combined fields of foundry science and engineering. The course assumes prior training in metallurgy, science, or engineering up to degree standard. Depending on their prior qualifications, students will be admitted to a Diploma or to a M.Sc. degree course. The candidates for a M.Sc. degree must possess a first degree of the required standard.

Lecture courses will be arranged to meet the requirements of those students taking the full one-year course. However, one or two brief lecture courses on selected topics will be arranged over short periods in such a way that they could be also attended by extramural students. Such short courses will be advertised in the daily and technical press. In addition to the lectures given by the full-time university staff, some lectures will be given by leading authorities in research organizations and in the foundry industry.

The subject matter of the lectures will be arranged in such a way as to outline the basic principles, but will deal mainly with advanced scientific knowledge and applications. For the benefit of those candidates who have not had adequate training in metallurgy, arrangements could be made for them to take suitable additional courses during their post-graduate year.

The basic course of lectures and practical work is planned to be completed by a full-time study in three terms beginning early in October. Full-time students proceeding to a Diploma will qualify through an examination held in June, whilst those seeking a M.Sc. degree will have to prepare a dissertation on a selected subject in addition to taking the examination. This work may be completed by the end of September.

The inclusive fee for the course is £81. In certain cases where a student is not sponsored by an employer, the University will consider applications for remission of this fee and, where necessary, for the grant of a maintenance allowance during the period of attendance.

Forms of application may be obtained from the Registrar, The University, Edgbaston, Birmingham 15, and further information about the course from the Secretary of the Department of Industrial Metallurgy at the same address.

Dislocations in Metals

A Vacation School on Dislocations in Metals and Inorganic Crystals will be held in the H. H. Wills Physical Laboratory during 24-29 March 1958. Lectures will be given by Professor F. C. Frank, Dr. J. W. Mitchell, Dr. J. F. Nye, Dr. N. Thompson, and other research workers from this country. Among the subjects treated will be: general concepts of the theory of dislocations, observations of dislocations in inorganic crystals, photoelasticity and dislocations, the theory of dislocation networks, interaction of point defects and dislocations, and dislocations and diffusion processes.

Further information can be obtained from the Director, Department of Adult Education, University of Bristol.

International Congress of Crystallography 1960

At the meeting of the International Union of Crystallography in Montreal in 1957, the British delegates issued an invitation in the name of the Royal Society and the University of Cambridge, on behalf of British crystallographers, for the next Congress to be held in Cambridge in 1960. The invitation was accepted and it has now been decided that the Fifth Congress will begin in Cambridge on 15 August 1960.

The Royal Society, as the national adhering organization to the International Union of Crystallography, has set up a local committee to organize the Congress and a number of scientific societies, including the Institute of Metals, have been invited to appoint one representative each to serve on a sponsoring Congress Committee.

DIARY

The Institute

25 February. Symposium on "Metallurgical Aspects of Semi-Conductors", arranged by the Metal Physics Committee. (College of Technology, Gosta Green, Birmingham, at 9.30 a.m.)

26 February. Informal discussion on "Fuel Efficiency in the Melting and Thermal Treatment of Metals", arranged by the Metallurgical Engineering Committee. (College of Technology, Gosta Green, Birmingham, at 10.30 a.m.)

Local Sections and Associated Societies

17 February. Sheffield Local Section. "Low-Carbon Bainitic Steels", by Dr. K. J. Irvine. (Engineering Lecture Theatre, University Buildings, St. George's Square, Sheffield 1, at 7.30 p.m.)

18 February. North East Metallurgical Society. "Modern Developments in Iron- and Steelworks Refractories", by H. M. Richardson. (Cleveland Scientific and Technical Institution, Corporation Road, Middlesbrough, at 7.15 p.m.)

20 February. Birmingham Local Section. "Neutron-Irradiation Effects in Metals", by Professor J. G. Ball. (Birmingham Exchange and Engineering Centre, Stephenson Place, Birmingham, at 6.30 p.m.)

26 February. Manchester Metallurgical Society. "Metallurgy of Tantalum, Niobium, and Beryllium", by Dr. G. L. Miller. (Manchester Room of The Central Library, Manchester, at 6.30 p.m.)

27 February. Southampton Metallurgical Society. "Non-Destructive Testing of Metals", by Dr. R. F. Hanstock. (Southampton University at 7.15 p.m.)

1 March. Liverpool Metallurgical Society. Annual Conversazione.

4 March. Oxford Local Section. "Nucleation and the Cast Structure", by Dr. V. Kondic. (Cadena Café, Cornmarket Street, Oxford, at 7.0 p.m.)

4 March. South Wales Local Section. "Metals for High-Temperature Service", by Dr. W. Betteridge. (Department of Metallurgy, University College, Singleton Park, Swansea, at 6.30 p.m.)

6 March. Birmingham Local Section. "The Metallurgy of Steel for Deep Drawing and Pressing—Part II", by A. J. K. Honeyman. (College of Technology, Gosta Green, Birmingham, at 6.30 p.m.)

APPOINTMENTS VACANT

6 March. Leeds Metallurgical Society. "Some Metallurgical Problems of Nuclear Energy", by Dr. H. K. Hardy. (Lecture Room C, Chemistry Wing, The University, Leeds 2, at 7.15 p.m.)

APPOINTMENTS VACANT

COPPER DEVELOPMENT ASSOCIATION requires the services of a young metallurgist to assist in dealing with technical enquiries. The appointment offers opportunities for a keen man to make himself thoroughly conversant with the metallurgical aspects of the copper industry. A degree and some practical experience in the casting and fabrication of copper and copper alloys, with a knowledge of their applications, are desirable. Commencing salary according to qualifications and experience, but not less than £800 per annum. A non-contributory pension scheme is in operation. Applications (marked confidential) should be sent to the Secretary, at 55 South Audley Street, London, W.1.

METALLURGISTS are required in the G.E.C. Atomic Energy Division for work on (a) the physical metallurgy of metals of interest in the nuclear-energy field, and (b) fuel elements. Applicants should be of degree standard. Salaries will depend on qualifications and experience. Apply in writing, stating age, qualifications, and experience, and quoting EML/12, to Personnel Manager, The General Electric Co., Ltd., Erith, Kent.

METALLURGISTS required for control and development work on the production of non-ferrous metals. A degree or equivalent qualification is necessary, with industrial experience. The posts have ample scope of advancement for people with initiative. Adequate salary based on qualifications and experience; contributory pension scheme; assistance with living accommodation after short period of service. Apply in confidence to Labour Manager, Enfield Rolling Mills, Ltd., Brimsdown, Enfield, Middx.

METALLURGISTS required in the Shepherds Bush laboratories of British Insulated Callender's Cables, Ltd., for Research and Technical service duties on a wide variety of problems dealing with both ferrous and non-ferrous metals of interest in the manufacture of electric cables, allied equipment, and transmission structures. Opportunities are available for gaining experience of industrial processes. Applicants should be well qualified and preferably have had some previous experience. Five-day week. Pension Fund. Applications, giving details of age, qualifications, and experience, should be made to Personnel Officer, 38 Wood Lane, London, W.12.

MINISTRY OF SUPPLY require Chemist (Metallurgist) at Harefield, Middlesex, to take charge of High-Temperature Materials Laboratory, with responsibility for high-sensitivity creep tests, metallography of titanium and heat-resisting alloys, heat-treatment, and pyrometry. Qualifications: British of British parents. Honours degree in Metallurgy or Associateship of the Institution of Metallurgists or equivalent. Considerable experience in Metallography and heat-treatment essential. Experience in mechanical testing and creep testing an advantage. Salary: £755 (at age 25)-£1180 p.a. Forms from M.L.N.S., Technical and Scientific Register (K), 26, King Street, London, S.W.1., quoting F.5/8A.

OSRAM METALS DEVELOPMENT LABORATORY

A **METALLURGICAL CHEMIST**, preferably a graduate, with or without industrial experience, is required for a post in a new and expanding section of this laboratory. The work covers the preparation and fabrication of refractory metals and a wide variety of allied problems.

The position requires a man who will display considerable initiative and versatility on work of an interesting and varied nature; training will be given with the potentiality of rapid promotion to Senior Development Engineer status. The position is permanent and pensionable after a qualifying period.

Applications, giving full details of qualifications and experience, to Personnel Officer, Osram Lamp Works, Brook Green, Hammersmith, W.6.

OSRAM METALS DEVELOPMENT LABORATORY

A **METALLURGICAL ENGINEER**, preferably a graduate, is required for a post in a new and expanding section of this laboratory. Experience is not essential, but a knowledge of Extraction and Powder Metallurgy

would be an advantage. The work covers the preparation and fabrication of refractory metals and a wide variety of allied problems.

Considerable initiative and versatility is required for work of an interesting and varied nature, and training will be given with the potentiality of rapid promotion to the post of Senior Department Engineer. The post is permanent and pensionable after a qualifying period.

Applications, giving full details of qualifications and experience, to Personnel Officer, Osram Lamp Works, Brook Green, Hammersmith, W.6.

OSRAM METALS DEVELOPMENT LABORATORY

TWO **METALLURGISTS** are required for the following development projects:

- (1) The extraction of tungsten and molybdenum and allied problems.
- (2) The processing of these materials to their finished state (a knowledge of fine wire drawing would be an advantage).

Applications, giving details of age, qualifications, and experience, to Personnel Officer, Osram Lamp Works, Brook Green, Hammersmith, W.6.

PHYSICIST or X-ray Crystallographer with postgraduate research experience required for fundamental research group in North London Laboratories. Some knowledge of metallurgy desirable. Salary according to age and experience. Apply in writing to Research Manager, Murex Welding Processes, Ltd., Waltham Cross, Herts.

RESEARCH INVESTIGATOR of high calibre required to undertake fundamental research work on metallurgical problems associated with welding and also to guide the activities of a small fundamental research team engaged in the study of such problems as kinetics of transformation in alloys, the state of gases in metals, and the mechanism of certain corrosion phenomena. Apply in writing to Research Manager, Murex Welding Processes, Ltd., Waltham Cross, Herts.

RESEARCH METALLURGIST

THE **MOND NICKEL CO., LTD.**, requires an investigator with qualifications in either metallurgy or physics, for work in connection with the development and use of high-temperature alloys.

The position carries a substantial degree of responsibility, and evidence of an ability to plan and control detailed programmes of work will be regarded as equally important as academic qualifications.

Promise of an attractive field of interest is offered to one who appreciates the use of modern physical and metallographic methods.

Salary will be in accordance with experience and qualifications. Pension and Assurance schemes are in operation and, in appropriate cases, assistance can be given for housing. Applications, which will be treated in confidence, should give details of age, qualifications, and experience and be addressed to the Manager, Development and Research Department, The Mond Nickel Co., Ltd., Thames House, Millbank, London, S.W.1. Please mark envelope "Confidential L.51".

SENIOR INFORMATION ASSISTANT, male, preferably 30-40, required at London (S.W.1) Head Office of The British Aluminium Co., Ltd. Experience in metallurgical industry and a degree in metallurgy or related sciences essential. Languages an advantage. Initial duties include responsibility for technical abstracting services, with scope for broader development. Good prospects. Applications in writing to The British Aluminium Co., Ltd., Norfolk House, St. James's Square, London, S.W.1.

STEEL TECHNICIAN required for works in Birmingham. Good qualifications in metallurgy and practical foundry experience essential. Job entails development and supervision of techniques and production in well-equipped modern plant. Candidates must have good personal qualities. Age not important. Commencing salary will depend on age and qualifications of successful candidate, but a four-figure salary is envisaged. Applicants should state age, education, experience, and present salary. Write to Box No. 439, The Institute of Metals, 4 Grosvenor Gardens, London, S.W.1.